

The effects of involuntary negative environmental disclosure: an event study in Brazilian companies with a high pollution index.

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Abstract

The aim in this study was to identify the influence of involuntary negative environmental disclosure on abnormal returns in sectors with high pollution indices: Exploitation, Refining, Metallic Minerals, Paper and Pulp and Iron and Steel. To achieve the proposed objective, the event study method was used, based on the Efficient Market Hypothesis. The sample selected totals 29 events, referent to the period from 2007 till 2012. T statistics of different variances was used, as well as the Wilcoxon test for paired variables, with a view to detecting whether the volatility of stock prices before the event is statistically different from stock prices after the event. The results demonstrated that the disclosure of environmental events negatively affected stock prices and returns, evidencing the semi-strong form of the Brazilian stock market, that is, the stock price reflects publicly available information in a rapid and precise manner. Also, the negative reaction of investors was observed until the third day after the event for the iron and steel and paper and pulp sectors, and until the fourth day after the event for the metallic minerals and exploitation and refining sectors, after which the stock prices and returns went back to normal levels. mumente utilizadas (tamanho, rentabilidade etc.) nos modelos de análise do nível de endividamento, contribuiu para o entendimento da estrutura de capital de empresas brasileiras.

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1. INTRODUCTION

Environmental disasters are the main risks modern society faces, as they can directly affect company activities, nature and human health. Environmental accidents that have happened since the 1970's have been widely disseminated in the Brazilian and international press (Blancard, Laguna, 2010). Among these accidents, the following can be highlighted: Amoco Cadiz in 1978, Exxon Valdez in 1989, Braer in 1993, Prestige in 2002, Piper Alfa on the North Sea in 1994, the Guanabara Bay oil spill from the REDUC refinery in 2000; sinking of the P – 36 platform in Campos Bay in 2004, oil spill in the Gulf of Mexico in 2010, caused by British Petroleum and the oil spill in Campos Bay in 2011 caused by the American oil company Chevron (Barros, Wasserman, Lima 2010).

Big environmental disasters enhanced researchers' interest in knowing the influence of involuntary environmental disclosure on stock prices, including: Shane and Spicer (1983); Muoghalu, Robinson and Glascok (1990); Hamilton (1995); Klassem e Mcaulin (1996); Lanoi, Laplante and Roy (1998); Karpoff, Lott and Rankine (1999); Matthew et al. (2000); Dasgupta, Laplante and Mamingi (2001); Freedman and Patten (2004); Brito (2005); Gupta and Goldar (2005); Karpoff, Lott, and Wehrly (2005); Jacobs, Singhal and Subramanaian (2008), Blancard and Laguna (2010).

These authors perceived that stock prices vary with the involuntary disclosure resulting from environmental accidents.

In Brazil, there are few studies about the theme, among which the following can be mentioned: Brito (2005); Nogueira, Angotti (2011), aimed at investigating investors' reaction to the involuntary disclosure resulting from environmental degradation. These authors used the event study method developed by Fama et al (1969), based on the Efficient Market Hypothesis (EMH). Brito (2005); Nogueira, Angotti (2011) found evidence that investors react to the dissemination of environmental accidents, demonstrating the efficiency of the Brazilian

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stock market.

In view of the above, the researcher took interest in investigating whether the environmental degradation different sectors have caused influences stockholders' purchase and sales decisions. Thus, the aim in this study is to analyze, in the light of the Efficient Market Hypothesis, the influence of involuntary negative environmental disclosure on the abnormal returns of Brazilian companies listed on BM&FBovespa.

Therefore, applying the event study method, the impact of involuntary negative environmental disclosure on stock prices was investigated in the companies Petrobrás, Vale, Fibria, Suzano Papel e Celulose, Gerdau, Cia Siderurgica Nacional and Usiminas between 2007 and 2012. These companies were chosen because they are classified as highly polluting entities in Brazil (2000).

These study results demonstrated that the Brazilian market assumes the EMH in the semi-strong form, which means that involuntary negative environmental disclosure exerts rapid and precise influence on stock prices and, consequently, on the companies' abnormal returns. Therefore, this research is justified by the need to show the Brazilian market's efficiency with regard to involuntary negative environmental disclosure, evidenced against the will of or without the company's permissions, as only three studies on the theme were found in the Brazilian context: Brito (2005), Nogueira, Angotti (2011) and Mendes (2012).

2. THEORETICAL FRAMEWORK

2.1. Efficient market hypothesis (EMH)

The efficient market hypothesis (EMH) started to be debated on as from the 1970's, when the work by Fama et al (1969) was published. The EMH predicts that the market is efficient if information affects the price of the assets traded, as this market consists of rational investors, whose purchase and sales decisions influence the stock prices. This theory is subdivided in three segments though: weak form, semi-strong form and strong form.

The weak form refers to when the market is efficient in weak terms, that is, the information is contained in past prices. Rabelo Junior, Ikeda (p.99, 2004) inform that:

$$P_t = P_{t-1} + \text{Expected Return} + \varepsilon_t,$$

in which the price today is a function of the last price observed, plus the expected return of the security and of a random component over time. The expected return of the security is a function of its risk and can be obtained using the models the market traditionally used, such as the CAPM. The random component, in turn, results from new information about the asset being priced. It can

be positive and negative, but its expected value is equal to zero.

The semi-strong form is considered when publicly available information, together with the company's past information and financial statements published, influence the stock price (Rabelo Junior, Ikeda, 2004; Silva, Takeuchi, 2010)

The strong form includes available and non-available information, that is, privileged or private information has been incorporated into the spot price of assets (Silva, Takeuchi, 2010).

To investigate the weak form of the Brazilian market, Gaio, Alves, Pimenta Junior (2009) analyzed the abnormal returns of the 50 stocks most traded on Bovespa between 2000 and 2007. The findings evidenced that there is no evidence of a weak efficient market in the Brazilian stock market.

According to Brito (2005), the Brazilian market is efficient in the semi-strong form because the stock price varies with public information disclosure, which means that information in the public domain influence stock prices.

Forti, Peixoto and Santiago (2009) analyzed the papers published in the main Brazilian finance congress annals to verify whether the authors accept or reject the EMH in the three efficiency types defined by Fama et al (1969). The authors found evidence that 42% of the papers accept the EMH in its weak form, while 58% reject it. In tests on the semi-strong form, 100% of the studies accept the EMH and, in tests on the strong form, 100% of the studies reject the EMH.

In this research, it is assumed that the Brazilian stock market is efficient in the semi-strong form, which means that environmental disclosure influences stock prices "in a rapid and precise manner" (Brito, P.42, 2005).

2.2. Negative environmental disclosure and elaboration of the hypothesis

Disclosure relates to the dissemination of the data needed to assess a company's performance. This disclosure should happen in a clear, useful and timely manner. Three types of disclosure are highlighted: voluntary disclosure, compulsory disclosure and involuntary disclosure.

Voluntary disclosure refers to spontaneous disclosure, that is, without any mandatory legislation. (Distadio, Fernandes And Yamamoto, 2009).

Compulsory disclosure refers to disclosure required by law and by regulatory entities. It is important to highlight that different corporate sectors have specific regulations, despite aiming for the standardization and credibility of the information disseminated (Distadio, Fernandes And Yamamoto, 2009). According to Miranda and Malaquias (2013), as a result of the IFRS, Brazilian companies are expected to disclose clearer

and more precise information, as the non-disclosure of environmental information causes a competitive disadvantage, so that companies are expected to lever their disclosure level to guarantee their credibility and, consequently, their attraction of investors.

Involuntary disclosure relates to disclosure against the company's will or without its permission (Skillius And Wennberg, 1998).

In this study, the researcher decided to study the involuntary disclosure of negative environmental information because of the big environmental disasters that have occurred since the 1970's, which were widely published in the Brazilian and international press.

With a view to examining investors' reactions to the positive and negative environmental events, Brito (2005) adopted the event method to collect environmental information and verify its consequences in the stock market. The author concluded that, between 1997 and 2004, the market did not react to positive environmental disclosure, but reacted to negative environmental information disclosure.

Mendes (2012), analyzed the influence of negative involuntary disclosure on stock price volatility between 1995 and 2010. The study findings evidenced that negative involuntary disclosure does not influence stock prices, differently from Brito's results (2005), which indicated that negative environmental information influences stock returns. These divergent results can be justified by the measures used as, while Mendes (2012) used volatility, Brito (2005) used abnormal stock returns.

Nogueira, Angotti (2011) analyzed the influence of oil spill disclosure on stock prices in the oil sector: Shell, British Petroleum, Petrobrás and Chevron, between 2000 and 2010. The authors found that negative environmental disclosure influences stockholders' purchase and sales decisions.

Nossa et al (2009) developed another study in Brazil to analyze the relation between abnormal returns and the social and environmental performance of companies traded on Bovespa, showing that environmental information disclosure does not influence the stock prices of Brazilian companies, that is, does not influence abnormal returns.

To examine the American market, Blancard, Laguna (2010) examined the stock market's reaction on the disclosure of 64 chemical disasters between 1990 and 2005 and perceived, on the day the environmental accident was disclosed, the company's market value dropped by 1% and, in the first week after the event, by 1.40%, demonstrating that the stock market puts environmental legislation in practice.

With a view to investigating the relation between environmental information disclosure and financial performance in the capital market among companies listed on the Portuguese stock exchange Euronext, Roque and Cortez (2006) analyzed 35 companies between

2000 and 2004, and concluded that companies that did not disclose environmental information revealed higher profitability levels than company that did publish this type of information during the period analyzed.

Karpoff, Lott and Wehrly (2005) investigated the penalties imposed on companies that violated environmental regulations. They examined 478 cases of environmental infractions disseminated in The Wall Street Journal between 1980 and 2000 and found signs that the stock values of companies investigated or accused of violating environmental standards suffered statistically significant drops. For announcements related to environmental accidents, the mean abnormal stock return was -1.69%, with t statistics of -3.25. For announcements about accusations filed against the company, the mean abnormal stock return corresponds to -1.58, with t statistics equaling -3.80. These results confirm the conclusion by Blancard and Laguna (2010) that negative environmental disclosure has a negative influence on stock value.

According to Hall and Ricck (1998), environmental information disclosure influences stock prices on the event date only, that is, on the day the information is disclosed. The same is not perceived, however, in the period -5 and + 5 days after the event appears.

Khanna et al (1998) studied investors' reactions to chemical industries' negative environmental disclosure in the United States. The study reveals a loss of stock value one day after the negative environmental information was disclosed, also affirming that the range of the investors' reaction depends on the extent of newspapers/magazines' dissemination of the negative environmental fact. This shows that investors react to the company's environmental performance, signaling their preference for positive environmental information. This influence can make companies invest in their environmental management to control its emissions and eliminate/reduce other environmental impacts.

Based on the abovementioned studies, which found evidence that involuntary disclosure about environmental impacts exerts a rapid and precise influence on stock prices, the following hypothesis was established:

H₁: Involuntary negative environmental disclosure reduces Brazilian companies' abnormal return.

3. METHOD

This study is aimed at investigating whether negative environmental disclosure influences abnormal returns in Brazilian companies. To reach the proposed objective, the event study method was chosen, which permits verifying the impact of a given event on stock prices.

This method is widely used in accounting and finance research, due to the belief that a given event directly

influences market behavior. The following publications have used the event study method: Myers, Bakay (1948); Barker (1956, 1957 and 1958); Ashley (1962); Ball, Brown (1968); Fama et al. (1969); Brown, Warner (1980 and 1985); Lipe (1990); Ahn, Sung (1995); Corthay, Rad (1996); Campbell, Lo, Mackinlay (1997) and Mackinlay, (1997). In Brazil, the event study method has been used in Perobelli, Ness (2000); Bernardo (2001); Sarlo Neto (2004); Brito (2005); Lima (2005); Pires (2006); Sarlo Neto, Lopes, Costa (2006); Nascimento (2006); Nogueira, Angotti (2011), among others.

In this research, the negative environmental disclosure published in newspapers between 2007 and 2011 was used as the event, referent to the following companies: Petrobrás, Vale, Fibria, Suzano Papel e Celulose, Gerdau, Cia Siderurgica Nacional and Usiminas classified as highly polluting companies in Brazil (2000). The

company Gerdau was excluded from the analysis as no environmental impact was found during the period under analysis.

To facilitate information collected, Internet search tools were used, applying the key words: environmental damage, environmental disasters, environmental impacts, environmental crimes, environmental destruction, environmental accidents, environmental degradation and environmental pollution. Twenty-nine negative environmental events were found, as shown in Table 1.

The information needed for this study was collected in two phases: in the first phase, the negative environmental information was collected, using the Internet search tools. In the second phase, stock prices were collected from the Economática database.

Table 1 shows the number of events obtained for the period under analysis.

Table 1. events

Sector	Company	Quantity of negative environmental disclosure
Fuel Exploitation, Refining and/or Distribution	Petrobras	11
Metallic Minerals	Vale	1
Paper and Pulp	Fibria	2
	Suzano papel e celulose	3
Iron and Steel	Gerdau Metalurgia	-
	Cia Siderúrgica Nacional	11
	Usina Siderúrgica de Minas Gerais (Usiminas)	1

Table 2 displays the date of the event and its description.

Table 2. Event characteristics

Company	Event date	Description of the event
Vale	03/03/2011	Yet another environmental crime resulting from Vale's work. A tugboat from a company hired by Vale turned over around 2h this Wednesday and spilt a lot of oil into the Mearim River, in the city Vitória do Mearim. The extent of the environmental crime remains unknown. The multinational has already surrounded the entire site with containment buoys to avoid the spreading of the oil. There is great revolt in the population. Water and fish supplies in Vitória may be compromised. The fear now is that the possible flood of the river, like what is happening in Trizidela do Vale, will spread oil across the riverside dwellers' houses.
Fibria	09/30/2009	A strong smell of sulfur was felt in the city Três Lagoas (MS). Fibria took responsibility for the spilling of a tank with chemical and organic compounds.
	11/13/2009	Yesterday, Fibria (formerly Votorantim Celulose e Papel – VCP), through its public relations, confirmed the R\$ 270 thousand fine applied by the Mato Grosso do Sul Institute for the Environment (Imasul)...Délia admits that the R\$ 270-thousand fine was low, but explains that what is important is the company's commitment to compensate for the damage through mitigating actions. Fibria was obligated to comply with four requirements imposed by Imasul, including the implementation of the Community Safety Prevention Program.
Suzano	11/09/2011	Producers with small rural properties, mainly producing papaya at the riverside, have been suffering due to the impact of the water that is being used for irrigation. As a result of the reduced water flow, the presence of pollutants has increased, causing the deaths of papaya plants. Thus, the production losses caused by the waste launched into the river water is changing the landscape...
	03/20/2012	The 5th panel of the Federal Regional Court of the 1st Region (TRF1) accepted the petition of the Regional Prosecutor of the 1st Region (PRR1) and decided to suspend an environmental license the Maranhão State Secretary of the Environment had granted to the company Suzano Papel e Celulose S/A to produce pulp on an area of 42 hectares...
	03/28/2012	In yet another investigative report about crimes in the extreme South of Bahia, the reporters Thiago Ramos and Claudio França end up discovering yet another environmental crime committed by Suzano Papel e Celulose, which has caused a true killing of fish by casting waste into the beds of the Mucuri River...

Table 2. Event characteristics (continued)

Company	Event date	Description of the event
Petrobras	5/19/2007	Federal judge Fabrício Antonio Soares, from the 1st Federal Court in Campos dos Goytacazes, condemned Petrobras to a R\$ 100-million fine because of the oil leak the sinking of the P-36 platform provoked in Camps Bay in 2001...
	09/24/2009	The environmental damage that affect a colony of fishermen in Guanabara Bay, caused by the installation of gas pipes and the construction of terminals by Petrobras in Guanabara Bay made the Prosecutor General (PG) propose a public civil lawsuit against the state-owned company. In the case, the attorney general Lauro Coelho Júnior demanded a compensation of R\$ 1,395, to be paid during 18 months, to each of the 96 fisherman families in the city of Magé. The total amount of the case corresponds to R\$ 2.4 million and aims to repair the collective moral damage caused to the artisanal fishermen.
	11/03/2009	Petrobras was condemned to pay a R\$ 6 million compensation for environmental damage caused to the city of Duque de Caxias, located on the Baixada Fluminense. ...
	3/18/2010	The tidal movement and marine currents provoked a slight disequilibrium in the hose, which provoked a crude oil spill. A small quantity was spilt (13.0 liters), which the currents, the high temperature and a small mechanical dispersion contributed to disperse...
	12/12/2010	Rio de Janeiro – Administrators of the Petrobras Refinery Duque de Caxias (Reduc) will be accused of environmental crime by the Federal Police (FP), due to effluents launched into the Iguaçu River, on the Baixada Fluminense. ...
	12/29/2010	São Mateus – Fishermen from the North of Espírito Santo demand compensation from Petrobras and Ibama for the socio-environmental damage caused by the Seismic Research, which started in the same month, hampers fishing and interferes in the reproduction of the fish... According to the fishermen, the sound waves scare away the fish...
	02/24/2011	Ibama (Brazilian Institute for the Environment) placed a R\$ 10-million fine on Petrobras because the company did not inform about an environmental accident that happened during the construction of a gas pipeline in Caraguatatuba, on the North coast of São Paulo.
	6/11/2011	Text from the public relations office of the Federal Regional Court – 5th region The Federal Regional Court – 5th region (TRF5), in its judgment session held last Tuesday (07), maintained the condemnation against Petrôleo Brasileiro S/A – Petrobrás for damage caused to the environment in the state of Sergipe, reducing the value of the fine. The sentence had condemned the public company to pay R\$ 500 thousand to the Association of Fishermen from Neighborhoods and Villages in the City of Maruim. The court reduced the fine to R\$ 150 thousand.
	09/11/2012	The Federal Police accuses Petrobras of dropping tons of untreated toxic waste into the sea, resulting from oil extraction on its sea platforms. According to the investigation by the FP's Environmental Crime Division in Rio de Janeiro, forwarded to the Federal Court, the company was not complying with toxic water treatment and discarding laws, also known as black water, a mixture of sea water and oil, grease and countless toxic substances.
	09/24/2012	The Federal Court denounced Petrobras and two managers of the Refinery Duque de Caxias (Reduc) for polluting the Guanabara Bay. According to Renato Machado, federal prosecutor in São João de Meriti, all analyses the State Institute for the Environment (Inea) elaborated in the previous year of effluents the refinery cast into the Iguaçu River concluded that the level of pollutants exceeded legally permitted levels. The river leads to the Guanabara Bay. According to the denouncement, the pollution caused by the irregular launching of oil, grease, phosphor, phenols and ammonium nitrogen causes damage to human health, kills animals and significantly destroys the mangroves.
11/03/2012	An oil spill assumed by Petrobras was registered this Friday in one of the pipelines that links the installations of the Refinery Landulpho Alves to the Terminal Madre de Deus, in metropolitan Salvador (BA)....	

Table 2: Event characteristics (continued)

Company	Event date	Description of the event
Cia Nacional	8/8/2009	A new oil spill by the Companhia Siderúrgica Nacional, in Volta Redonda, in the South of the State of Rio de Janeiro, has again struck the Paraíba do Sul River, which supplies about 85% of the population in the state...
	08/11/2009	The Companhia Siderúrgica Nacional (CSN) received a R\$ 5 million fine for the oil spill that affected the Paraíba do Sul River in Volta Redonda, in the South of Rio de Janeiro...
	10/04/2010	The Companhia Siderúrgica Nacional (CSN) will be obliged to invest R\$ 216 million in environmental adaptations at the Presidente Vargas plant in Volta Redonda, Rio de Janeiro. The company closed an agreement with the State Secretary of the Environment by signing the Adjustment of Conduct Agreement (TAC). The signing is a preliminary condition to renew the company's environmental licenses...
	11/30/2010	The Effluent Treatment Station of CSN's blast furnace in Volta Redonda spilt carbon and iron ore into the Paraíba do Sul River, which has already been contained. CSN can receive a fine of up to R\$ 50 million. The amount will be determined based on the report by the State Institute for the Environment (Inea). Victor expects that CSN will receive an exemplary punishment, as this type of accident has been frequent in the company...
	12/09/2010	The Rio de Janeiro State Secretary of the Environment issued a R\$ 20.1 million fine against the (CSN) for spilling toxic waste into the Paraíba do Sul River in Volta Redonda (RJ). ...
	5/11/2011	The Federal Court has started a public civil case against the iron and steel company for Márcia 1, the first industrial open-air landfill, discovered in August 2010. The Court calculate a fine of R\$ 1 thousand per cubic meter, which would represent about R\$ 500 per ton of residues. As the site consists of 300 thousand cubic meters and about 540 thousand tons of industrial material, the value of the matter in controversy is about R\$ 300 million....
	11/03/2011	RIO – The state secretary of the Environment, Carlos Minc, affirmed this Wednesday that the Companhia Siderúrgica Nacional (CSN), in Volta Redonda, will have to invest more than R\$ 16 million to recompose the riparian vegetation and restock the fish in the Paraíba do Sul River.
	11/04/2011	RIO - The Companhia Siderúrgica Nacional (CSN) is expected to sign by next Monday the Adjustment of Conduct Agreement (TAC) in order to get environmental licenses approved by the State Government in Rio. According to the agreement, CSN has to invest R\$ 250 million in the next three years to correct environmental problems at the Presidente Vargas plant in Volta Redonda...
	07/05/2012	The Federal Court (MPF) in Volta Redonda (RJ) has filed a public civil complaint against the Companhia Siderúrgica Nacional (CSN) for causing environmental and health damage. In the lawsuit, R\$ 87.1 million is demanded for environmental damage caused by industrial waste deposits without a regular environmental license. Today, the site is occupied by a neighborhood, Volta Grande 4, in an area the company donated to the Union of Steel Workers...
	12/12/2012	São Paulo - The Companhia Siderúrgica Nacional has received an 881-thousand-real fine for breaking an environmental agreement closed in 2010 to recover areas degraded by carbon exploitation, according to information by the Federal Court in Criciúma, in the same state. According to the court "eight areas under the responsibility of CSN have been identified, which did not comply with the recovery timetable". Representatives from CSN were not readily available to comment on the issue...
12/19/2012	The CSN (Companhia Siderúrgica Nacional) received an R\$ 11.596 million fine for not complying with 17 out of 114 items established in the TAC (Adjustment of Conduct Agreement) it signed with the State Secretary of the Environment in October 2010. The amount of the fine was announced this Wednesday (19) by the state secretary of the environment, Carlos Minc, and by the chairwoman of Inea, Marilene Ramos.	
Usiminas	07/01/2011	The Court in Rio de Janeiro accepted an environmental crime complaint the State Prosecutor filed against Usiminas, due to possible irregularities in an audit at Thyssenkrupp Companhia Siderúrgica do Atlântico (CSA), in Santa Cruz, West of Rio de Janeiro City, where it verified pollution and health damage to the community caused by steel production...

Obs.:* amount of the event divided by Total Assets

Source: Elaborated by the author

Table 3. Event characteristics

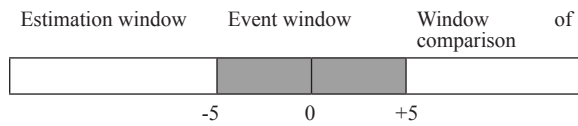
Company	Event date	Publication source	Information type	Information characteristics		Monetary value of the event	*Relevance of the value %
				Qualitative	Quantitative monetary		
Petrobras	05/19/2007	Folha de São Paulo	Negative	Yes	Yes	100 million	0.004
	09/24/2009	Eco Debate	Negative	Yes	Yes	2,4 million	0.0069
	11/03/2009	Terra	Negative	Yes	Yes	6 million	0.0174
	03/18/2010	Ibama	Negative	Yes	No	-	-
	12/12/2010	EPTV	Negative	Yes	No	-	-
	12/29/2010	Folha Acadêmica	Negative	Yes	No	-	-
	02/24/2011	UOL	Negative	Yes	Yes	10 million	0.0167
	06/11/2011	UOL	Negative	Yes	Yes	150 thousand	0.0003
	09/11/2012	O dia	Negative	Yes	No	-	-
	09/24/2012	Extra globo	Negative	Yes	No	-	-
	11/03/2012	Jornal do Brasil	Negative	Yes	No	-	-
Vale	03/03/2011	Justiça.org	Negative	Yes	No	-	-
Fibria	09/30/2009	Brasil Economico	Negative	Yes	No	-	-
	11/13/2009	Brasil Economico	Negative	Yes	Yes	270 thousand	0.010
Suzano	11/09/2011	Portal N3	Negative	Yes	No	-	-
	03/20/2012	Eco Debate	Negative	Yes	No	-	-
	03/28/2012	Teixeira agora	Negative	Yes	No	-	-
Cia Nacional	08/08/2009						
	Eco Debate	Negative	Yes	No	-		
	08/11/2009	UOL	Negative	Yes	Yes	5 million	0.1714
	10/04/2010	O globo	Negative	Yes	Yes	216 million	5.7141
	11/30/2010	Eco Debate	Negative	Yes	Yes	50 million	13.227
	12/09/2010	Jornal do Brasil	Negative	Yes	Yes	20.1 million	0.5317
	05/11/2011	UOL	Negative	Yes	Yes	300 million	6.4007
	11/03/2011	O globo	Negative	Yes	Yes	16 million	0.341
	11/04/2011	O globo	Negative	Yes	Yes	250 million	5.3339
	07/05/2012	Jornal do Brasil	Negative	Yes	Yes	87.1 million	18.487
	12/12/2012	Exame	Negative	Yes	Yes	881 thousand	0.0187
	12/19/2012	R7	Negative	Yes	Yes	11.596 million	0.2461
Usiminas	07/01/2011	O globo	Negative	Yes	No		

Obs.:* amount of the event divided by Total Assets

Source: Elaborated by the author

To use the event study method, some steps need to be established, including:

- a) **Event date** – refers to the date when the event occurred, also called zero date. In this study, the event date is considered as the date when the negative environmental information was published (Brito 2005; Nogueira And Angotti, 2011).
- b) **Event window** – relates to the period when the stock price will be analyzed. In this research, the event window was established as (- 5) to (+ 5), that is, the stock value will be registered five days before and five days after the event. According to Camargos and Barbosa (2003), the choice of the event period is very subjective and should comprise relevant and not very long periods, so as to avoid the risk of covering other events than that under analysis.
- c) **Estimation window** – consists of 50 observations of stock prices that are supposedly exempt from the event's impacts. According to Galeno et al (2010, p.7) “The estimation window should be broad enough to dilute possible discrepancies in stock prices, avoiding significant changes in its frequency distribution”.
- d) **Window of comparison** – used to observe stock price volatility 10 days after the event, with a view to verifying whether these will return to normality.



According to Nogueira and Angotti (2011), the estimation window is used to calculate the abnormal returns before the announcement of the event and to compare it with the window of comparison.

The normal return is defined as the return expected without the condition that the event will happen, while the abnormal return is defined as the stock return observed *ex post* minus the company's normal return during the event window. (Camargos, Barbosa, 2003, P.3)

The stock return was calculated according to the proposal by Soares, Rostagno, Soares (2002), also used in Nascimento (2006); Takamatsu, Lamounier, Colauto, 2008; Nogueira, Angotti (2011), as evidenced in equation 1:

Where:

$$r = \ln(\beta_t / \beta_{t-1})$$

r = rate of return

\ln = logarithm

β_t = stock price on date t

β_{t-1} = stock price on date $t-1$

To estimate the expected return, the model adjusted to the market was used, obtained through simple linear regression, considering the returns of each stock as the explained variable and Ibovespa returns as the explanatory variable, which was also used in the research by Nascimento, (2006); Takamatsu, Lamounier, Colauto, (2008); Nogueira, Angotti, (2011), according to equation 2:

$$E(r_{i,t}) = \alpha_{i,t} + \beta r_{m,t} + \varepsilon$$

Where:

$E(r_{i,t})$ = Expected return of company i in period t ;

α_i = Interceptor of company i obtained through the least squares method

β_i = Variation coefficient of company i in period t ; obtained through the least squares method

$r_{m,t}$ = Market return in period t , obtained by the Ibovespa logarithm.

ε = error

Thus, the abnormal return is the difference between the expected return and the stock return, as shown in equation 3. The same model was used in the study by Nascimento (2006):

$$RA = r_{it} - E(r_{i,t})$$

Where:

RA = Abnormal return for company i in period t ,

r_{it} = Return of company i in period t ,

$E(r_{i,t})$ = Expected return according to market trend for company i in period t .

To check the impact in the event window, the accumulated abnormal return needs to be calculated, using the arithmetic means of the grouped stocks' abnormal returns. This method permits measuring the mean abnormal returns for the set of stocks/companies with the same profit or loss result. (NASCIMENTO, 2006, p.60). According to equation 4:

$$RAA(-5,+5) = \Sigma RA$$

In this study, the logarithm of the returns was used as shown in equation 5. According to Nogueira and Angotti (2011, p.75), the logarithmic form permits "analyzing the general effect on individual stocks in a sample with N observations".

$$RAA(-5,+5) = \ln \Sigma RA$$

To check the significance of the returns in the event window, the t-test was used to check for mutual differences in the mean returns.

3.1 Statistical procedures

To test the hypothesis established in the study, the following statistical methods were used.

1- Parametric test

The distribution of the t-statistics is normal for a sample of 30 or more, and approximates normality in larger samples. In this research, the t-test of different variances was applied (Stevenson, 1991).

2- Non-parametric test

Do not need normality, and are therefore weaker than the parametric tests. The most used non-parametric tests are the signs and rank tests, also known as signed rank tests (Mackinlay, 1997). In this study, Wilcoxon's non-parametric signed rank test was chosen, which is adopted to check whether the measures of two samples are equal for dependent samples, as evidenced in equation 5, also used in the study by Pestana and Gageiro (2008) and Mendes (2012):

$$Z = (R - \mu R) / \sigma R$$

Where,

R = Critical value of test significance

μR = Mean

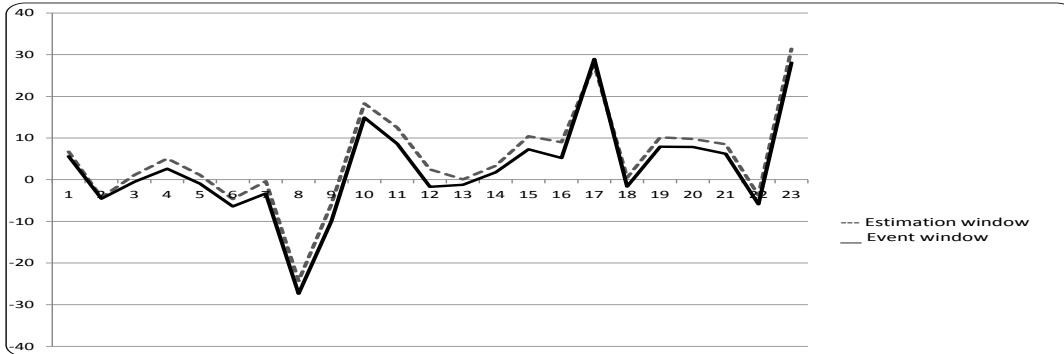
σR = Variance

For the tests, significance was set at 5% as, according to Stevenson (1981, p.225), the significance of the test used evidences the probability that a "null-hypothesis will be rejected, when true".

4. RESULT ANALYSIS

The study sample included the stocks of the companies Petrobrás, Vale, Fibria, Suzano Papel e Celulose, Gerdau, Cia Siderúrgica Nacional and Usiminas. To verify the impact environmental disclosure caused between 2007 and 2012, the event study method was used, based on the Efficient Market Hypothesis.

Graph 1 evidences the market’s reaction to negative environmental information disclosure. In relation to the estimation window, stock values drop between the event windows (-5,+5), demonstrating that stockholders react to the disclosure of environmental events, in accordance with Brazilian and international studies about the influence of involuntary environmental information disclosure on stock prices.

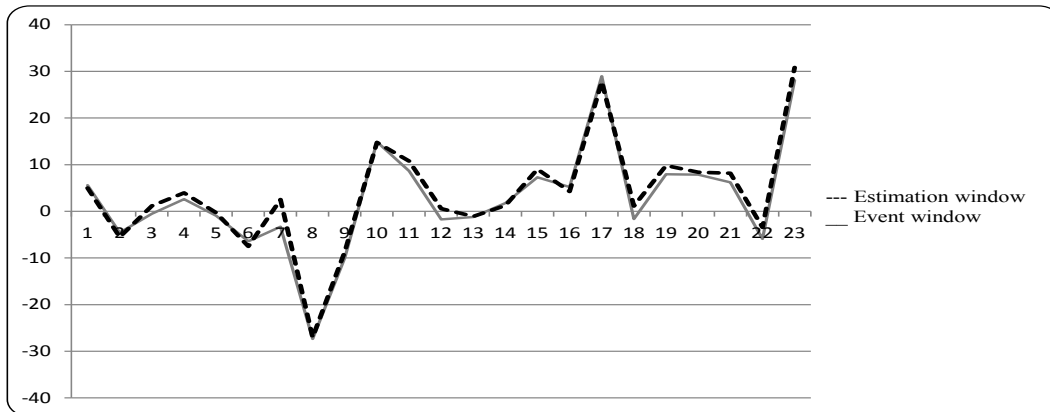


Graph 1. Estimation window x event window

Source: elaborated by the author

Graph2 shows that, after the event was announced, abnormal stock returns tend to return to normal, showing the information efficiency in the Brazilian market. Information efficiency relates to the impact the disclosure

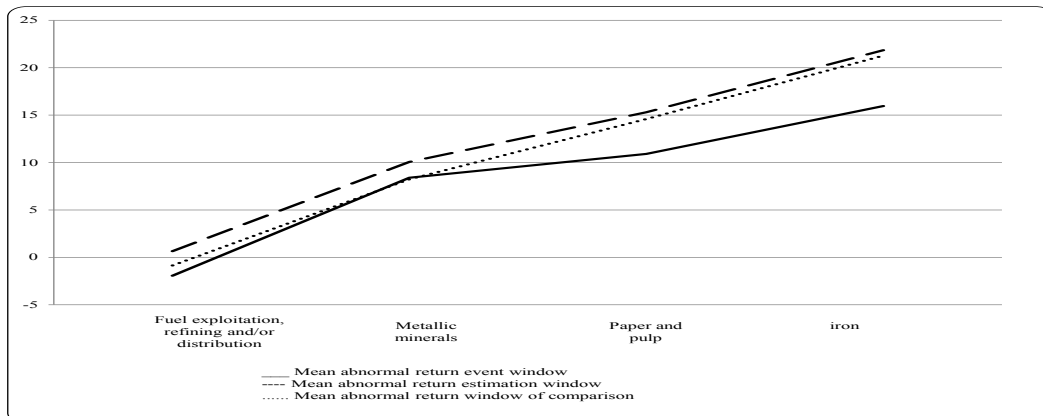
of an event had on the stock prices, in other words, it precisely reflects the reactions of investors interested in future cash flows (Malaquias, Carvalho And Lemes, 2010).



Graph 2. Event window x window of comparison

Source: elaborated by the author

Graph 3 shows the evolution of the mean abnormal return of each sector analyzed.



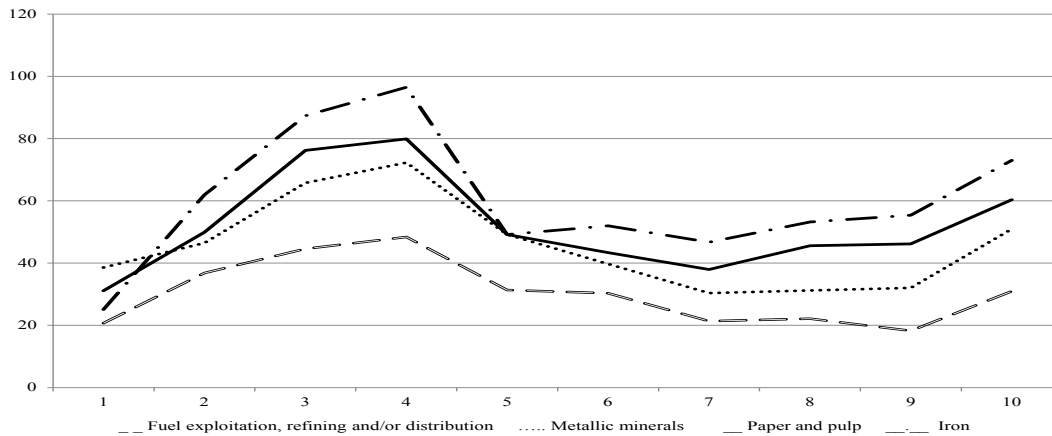
Graph 3. Mean abnormal return of sectors

Source: elaborated by the author

As shown in Graph 3, the Paper and Pulp and Iron sectors showed a mean abnormal return in the event window far below the mean abnormal return of the estimation window, demonstrating that these companies were punished more because of the environmental disaster than the other sectors under analysis. The same graph also illustrates the effect of the efficient market theory, as the mean abnormal return of the window of comparison evidences that, after the event, the mean

returns go back to normal levels.

The impact of the event on the abnormal returns of the sectors under analysis is better shown in Graph 4, demonstrating the investors' negative reaction up to the third day after the event for the iron and paper and pulp sectors and up to the fourth day after the event for the metallic minerals and exploitation and refining sectors, after which the mean return levels are recovered.



Graph 4. Abnormal return of sectors
Source: elaborated by the author

The verify the actual impact of negative environmental disclosure on stock prices, the t-test of different variances was applied, comparing the mean returns of the estimation window with the mean returns of the event window, as displayed in Table 3:

Table 3. t test

	Fuel exploitation, refining and/or distribution	Metallic minerals	Paper and pulp	Iron
Stat t	0.86782	0.6283	0.6683	0.1874
Critical value one-tailed t	1.7171	1.85954	1.9431	1.9431

T-statistics were lower than the critical t-value, indicating that the negative involuntary disclosure of environmental accidents exerted a rapid and precise influence on stock prices, demonstrating the semi-strong efficiency of the Brazilian market, in accordance with the Efficient Market Hypothesis. It can be inferred that negative environmental disclosure is segmented into legal expenses, environmental recovery, safety costs, publicity expenses and drop in sales. These factors directly influence the companies' cash flow and, therefore, investors react to the disclosure of the environmental impacts (Fernandes, 2011).

Table 4. Wilcoxon's non-parametric test

Wilcoxon	Before - After
Test statistics	283.0

To check for statistical differences, Wilcoxon's non-parametric test was applied, comparing the intensity of stock price variations before and after the event.

5. CONCLUSION

This study considered the stocks of Petrobrás, Vale, Fibria, Suzano Papel e Celulose, Gerdau, Cia Siderúrgica Nacional and Usiminas. The choice of these companies is due to the fact that Brazil (2000) classifies them as highly polluting. Newspaper disclosure about the environmental degradations these Brazilian companies have caused aroused the researcher's interest in knowing the influence this type of information caused, evidenced against its will or without the company's permission.

To check this impact in the stock market, the event study method was chosen, which permits identifying the impact before, during and after the event, in accordance with the Efficient Market Hypothesis.

These study findings demonstrated that negative information disclosure influences stock returns. At the time the information is published, the company's market value drops, that is, stock prices are reduced until the third day after the event for the iron and paper and pulp sectors and until the fourth day after the event of the

metallic minerals and exploitation and refining sectors, returning to normal levels after that period. The results also showed that the market punishes the iron and paper and pulp sectors more severely than the metallic minerals and exploitation and refining sectors, considering the sharp drop in stock returns during the event window (-5, +5).

These findings were confirmed by the t-statistics, which was lower than the critical t, permitting the acceptance of the research hypothesis and supporting Brazilian studies by Brito (2005) and Nogueira, Angotti (2011), as well as some international studies: Hamilton (1995); Khanna, Bojilova (1998); Karpoff, Lott, Wehrly (2005); Blancard; Laguna (2010).

In addition, a sharp drop was perceived in the mean stock returns of the paper and pulp and iron sectors, which returned to normal levels as from the fourth day after the event. This result demonstrates that the stock market reacts negatively to environmental disasters, punishing the offenders, mainly in the sectors investigated.

In accordance with Baber and Lyon (1996), considerable variation exists in the accounting measures and statistical tests used to detect abnormal performances. Hence, different results can be reached depending on the model used. Aiming to investigate the existence of abnormal performances after corporate events in Brazilian companies, Maia de Paula and Vieira, (2012, p. 90) found signs that, except for some few studies, “the results are statistically inconclusive, which in some cases can be justified by the use of small samples”.

Thus, based on the results by Baber and Lyon (1996), Maia de Paula and Vieira, (2012), it was concluded that the statistical tests adopted may have influenced the study results. Also, the sample size should be highlighted, so that these results cannot be applied to the Brazilian context.

Study limits include the period analyzed, the number of companies studied, the statistics adopted, the sectors chosen and the information collected as, according to Nogueira, Angotti (2011), different disclosure forms exists, making it impossible to identify the exact time when the stockholders received the negative environmental information. Another limitation is due to media bias, as the degree of disclosure can influence the stockholders.

For the sake of future studies, other sectors could be analyzed, as well as a broader sample, with a view to comparing the level of impact among different activity areas.

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